Detecting and Understanding Environmental and Ecological Change In National Parks of Southwestern Alaska

National Park Service
Inventory & Monitoring Program
Southwest Alaska Network

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Southwest Alaska Network
National Park Service
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www.nature.nps.gov/im/units/swan/

Staffing and Organization

Southwest Alaska Netowrk is a coalition of NPS network, regional office, and park-based staff. The five-member Board of Directors consists of three superintendents representing the park units and two advisors from the Alaska Regional Support Office. The seven-member Technical Committee consists of the chiefs of resources management from each park, the network coordinator (chairman) and three advisors who do not directly work for the parks.

Core Staff:
Alan Bennett, Network Coordinator
Dorothy Mortenson, Data Manager
Laurel Bennett, Aquatic Ecologist
Bill Leacock, Inventory Coordinator
Bill Thompson, Network Biometrician

Board of Directors:
Anne Castellina, Superintendent Kenai Fjords National Park
Joe Fowler, Superintendent Katmai National Park and Preserve
Deb Liggett, Acting Superintendent Lake Clark National Park & Preserve
Sara Wesser, Regional Inventory & Monitoring Program Coordinator
Bob Winfree, Regional Science Advisor

Technical Committee:
Alan Bennett, Network Coordinator
Troy Hammon, Katmai National Park and Preserve
Ian Martin, Kenai Fjords National Park
Judy Putera, Lake Clark National Park & Preserve
Karen Oakley, US Geological Survey, Biological Resources Division
Page Spencer, Alaska Regional Support Office
Sara Wesser, Alaska Regional Support Office

NPS Service-wide Vital Signs Monitoring Goals

1. Determine status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources.

2. Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.

3. Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.

4. Provide data to meet certain legal and congressional mandates related to natural resource protection and visitor enjoyment.

5. Provide a means of measuring progress toward performance goals

Abstract

The Southwest Alaska Network (SWAN) includes five units of the National Park Service (NPS):

1. Alagnak Wild River,
2. Aniakchak National Monument and Preserve,
3. Katmai National Park and Preserve,
4. Kenai Fjords National Park, and
5. Lake Clark National Park and Preserve.

Collectively these units comprise 9.4 million acres, 11.6 percent of the land managed by the NPS, and 2 percent of the Alaska landmass. Network parks encompass climatic conditions, geologic features, pristine ecosystems, natural biodiversity, freshwater, and marine resources equaled few places in North America. These wilderness parks are a unique resource and offer unparalleled opportunities to learn about ecological systems minimally affected by humans.

In 2001, the SWAN initiated a series of biological inventories to begin the process of developing a long-term vital signs* monitoring program to collect scientifically sound information on the status and long-term trends of park ecosystems and to determine how well current management practices are sustaining the resources that they were created to protect. In this poster, we describe the networks approach to planning this program and provide a progress report on inventories and research that will guide its eventual design. Accomplishments during the early years of planning include: a) staffing and organization; b) literature review and data mining; c) development of ecosystem-based and issue-based conceptual models; d) use of scooping workshops to review models, develop monitoring questions, and identify physical and biotic drivers, human-related stressors, and candidate vital signs; and e) biological inventories, research, and landscape modeling in support of long-term monitoring.

A vital sign (also known as an indicator) is any measurable feature of the environment that provides quantitative information on ecological resources and insights into the state of park ecosystems.

Baseline Inventories, Research, and Resource Mapping in Support of Vital Signs Monitoring

Inventories of vascular plants, fish, birds, mammals, and marine macroinvertebrates are being undertaken to document occurrence and distribution of species, some of which may be candidates for monitoring. Similarly, inventories are targeting rare and distinctive plant and animal communities such as salt marshes and coastal alpine tundra, or communities that develop on recently deglaciated terrain. Paleoecological research will help us understand the ecological history and processes that shaped the landscape. Finally, computer modeling using existing digital data layers will lead to a better understanding of these complex park landscapes, how they are changing, and which habitats are most sensitive to change.

Inventories

- Vascular Plants
- Freshwater Fish
- Small Mammals
- Montane Birds
- Coastal Forest Birds
- Wolverine and River Otters
- Black Bear Genetics
- Refugia and Rare Communities
- Baseline Water Quality
- Amphibians
- Marine/Estuarine Benthic Invertebrates

Freshwater Fish Inventory

Freshwater fishes are an important component of ecosystems within Alaska Parks. Unfortunately, little is known about the occurrence, distribution or relative abundance of many freshwater fish species within the Southwest Alaska Network. To date, only Katmai National Park and Preserve and Lake Clark Park and Preserve have received fairly comprehensive freshwater fish surveys that document the occurrence of freshwater fishes of consumptive and non-consumptive value. Much of our current freshwater fish knowledge focuses on species harvested by subsistence or sport users, and little information is available on species such as blackfish, lamprey, sculpin, sticklebacks, and whitefish. The objective of this project is to document through targeted sampling the occurrence of 90% of freshwater fish species expected to occur in lakes and streams in the Southwest Alaska Network.

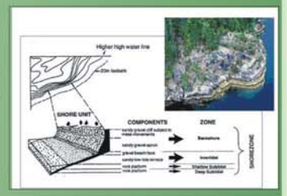

Measuring Pike in Alagnak Wild River

Habitat Mapping

- Coastal ShoreZone Habitats
- Satellite Imaging & Landcover
- Salt Marshes
- Glaciers

Coastal Habitat Inventory and Mapping

If marine coastal shorelines are to be protected and monitored, the types of intertidal habitats and the plant and animal communities they contain must be mapped using a consistent classification. 'ShoreZone' is a coastal habitat mapping procedure that has been widely used in the Pacific Northwest to map coastal geomorphology and coastal biota. ShoreZone has been applied to the entire coast of Washington and British Columbia and in Alaska to Cook Inlet and the Kenai Peninsula, including the entire coastlines of Lake Clark and Kenai Fjords National Parks. In 2003, Dr. John Harper, Coastal and Oceans Inc., will use 'Shorezone" to map habitats along the coasts of Katmai and Aniakchak National Parks. Once completed, this network-wide GIS-based inventory and classification will support the planning and design of coastal monitoring and the selection of sites for more detailed research and monitoring that can detect environmental change.



Ecological History

- Paleolimnology
- Paleoenvironmental Reconstruction & Landscape Interactions
- Historic Photograph Database & Options for Photo Point Monitoring

Paleoenvironmental Reconstruction of Landscape Interactions and Salmon Abundance

Knowing how landscapes have evolved, changed, and responded to geologic and climatic drivers is important for designing a long-term monitoring program and interpreting data acquired in the future. For example, paleo-data can reveal how climatic, oceanographic and landscape processes interact with lakes and the salmon runs that they support. In turn, this long-term perspective can provide baseline data that will lead to understanding of how humans have influenced lake ecosystems. In 2003-2005, Dr. Bruce Finney, Institute of Marine Science, University of Alaska-Fairbanks will collect and analyze lake corings to reconstruct past changes in salmon abundance and lake primary productivity; and Dr. Patricia Heiser, Dept of Geology, University of Alaska-Anchorage will analyze lake sediment cores to estimate timing of deglaciation; timing and degree of lake level changes; tephra chronology and age of volcanic ashes; and reconstruct the history of vegetation succession since the last lice age by analyzing pollen found in sediment cores.

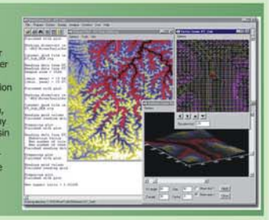

Lake core sampling in Meshik Lake, Aniakchak National Monument & Preserve

Modeling

- Climate Modeling
- Landscape Simulation Modeling & Identification of Areas Sensitive to Change
- Hydrographic Modeling
- River Gauging

Hydrographic Modeling

The task of locating long-term monitoring sites in large watersheds can be difficult. 'RiverTools' is a GIS application for analysis and visualization of digital terrain, watersheds and river systems that provides accurate measurement of river characteristics such as upstream area, channel lengths, elevation drops and slope. In 2003, Dr. Robert Stallard, USGS-National Research Program and Institute for Arctic and Alpine Research, University of Colorado, Boulder will create detailed hydrography of each network park using RiverTools. River channels and basin boundaries will be delineated using digital elevation models (DEMs). The final products will include a GIS database of river networks derived from the DEM and extant vector maps of the river networks and a classification of subbasins and major channels throughout the parks.



Information Synthesis

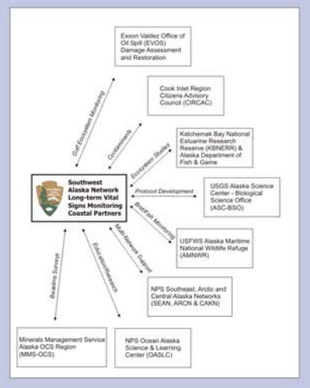
Scoping Workshops

Scoping workshops were held to review and discuss the current state of knowledge concerning park ecosystems, resource protection issues, and potential options for monitoring. Most workshops had a community or ecosystem focus and workshops were ordered in sequence: ocean freshwater terrestrial . In each case, the objectives were to: 1) review/refine conceptual ecosystem models and monitoring questions; 2) identify drivers of change and why it is important to understand them; and 3) identify candidate attributes to monitor that provide reliable signals about ecosystem condition. The technical committee, NPS staff from other networks and the Alaska Regional Office, and scientists from universities, State of Alaska agencies, and other federal agencies attended the workshops.


Coastal Scoping Workshop
Alaiik Bay, Kenai Fjords National Park

Monitoring With Partners

To identify partnership opportunities and benefit from monitoring efforts conducted by other federal and state agencies, we reviewed global, national, regional, and local monitoring efforts that may be relevant to natural resource monitoring in the SWAN. A portion of this survey was accomplished using questionnaires that were mailed to agencies, universities, and private research or conservation organizations. We compiled information into databases of existing and planned research and monitoring within ecoregions encompassed by the network. Other partnership opportunities emerged during our interagency scoping workshops.



Data Mining

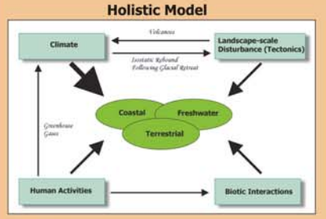
The Inventory and Monitoring Program requires a thorough Data Mining Project. The purpose of the Data Mining Project is to find and catalog data and information relating to natural resources within the park or in the vicinity of the park in order to develop the monitoring plan.

The Data Mining Project consists primarily of two types of documentation: a bibliography and metadata. The bibliography documents formal and informal reports, articles, and books. Metadata information documents databases, geographic information system (GIS) data, and spreadsheets. Both of these types of documentation will be searchable from the internet.

Scientific Framework

Conceptual models portray our understanding of landscape-scale drivers and ecological interactions and how they may affect selected natural resource processes and components of the SWAN parks. The models, and process of creating them, assisted us in the formulation of specific monitoring questions and provided a basis for identification and selection of ecological vital signs for long-term monitoring. We prepared conceptual models of coastal, freshwater, and terrestrial subsystems for each scoping workshop. Model development required extensive literature review and consultation with research scientists and landscape ecologists familiar with subarctic ecosystems.

Holistic Model



Holistic Model: Major driving forces shaping park ecosystems are climate, landscape-scale disturbance, biotic interactions, and human activities. The model depicts the close linkages between the primary subsystems (coastal, freshwater, terrestrial) of park ecosystems and feedbacks between the drivers. Drivers can act independently and interactively. For example, volcanic eruptions are a tectonic disturbance that can lower air temperatures.

Ecosystem Interactions Model

Ecosystem Interactions Model: Key linkages and interactions between the atmosphere, ocean, and land in the Southwest Alaska Network. Hydrologic and biochemical interactions with terrestrial and aquatic ecosystems control the formation of habitats and distribution of plants and animals.

Monitoring Questions

- How are seasonal discharge regimes of glacial and snowmelt rivers shifting?
- How are vegetation communities changing across the SWAN in response to the primary environmental drivers of weather, tectonics, large-scale disturbances, and human activities?

Landscape Perspective

The Southwest Alaska Network and its surrounding landmass, glaciers, lakes, rivers, and marine coastline are an interconnected landscape. Within this interconnected whole, at time-scales of years to decades, climate, natural disturbance, biotic interactions, and human activities are the most important driving forces in determining ecosystem structure and function. Consequently, our monitoring program must address the interplay of multiple forces, which occur at a variety of spatial and temporal scales, in order to understand the structure and function of network ecosystems.


Mt Redoubt and coastal lowlands,
Lake Clark National Park & Preserve

Future Plans

During 2004 network staff will synthesize and prioritize the many ideas for monitoring that emerged during the past two years and develop a strategy for undertaking the most critical of these though an integrated, yet targeted monitoring program. This process will rely heavily on scoping workshops, the material compiled and reported in the networks Phase I Report. (Report can be found at www.nature.nps.gov/im/units/swan/, "Vital Signs Monitoring Plan.") Network personnel will examine candidate vital signs in the context of monitoring objectives and questions. For example, do the monitoring questions capture the issues of concern identified by network parks? Or, will monitoring of candidate vital signs lead to an understanding of the problems poised by the questions?

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